(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 June 2001 (21.06.2001)

PCT

(10) International Publication Number
WO 01/45034 A1

(51) International Patent Classification[7]: G06K 9/00, 9/18, 9/62, 9/64, 9/68, G06F 15/00, H03K 17/94, 11/00

(21) International Application Number: PCT/US00/33214

(22) International Filing Date: 7 December 2000 (07.12.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/466,344 17 December 1999 (17.12.1999) US

(71) Applicant: MOTOROLA INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US).

(72) Inventors: WU, Charles, Yimin; BLK 602, Clementi West St. 1 #12-26, Singapore (SG). GUO, Jin; 1589 Black Hawk Drive, Sunnyvale, CA 94087 (US).

(74) Agents: BOSE, Romi, N. et al.; Motorola Inc., Intellectual Property Dept., 1303 East Algonquin Road, Schaumburg, IL 60196 (US).

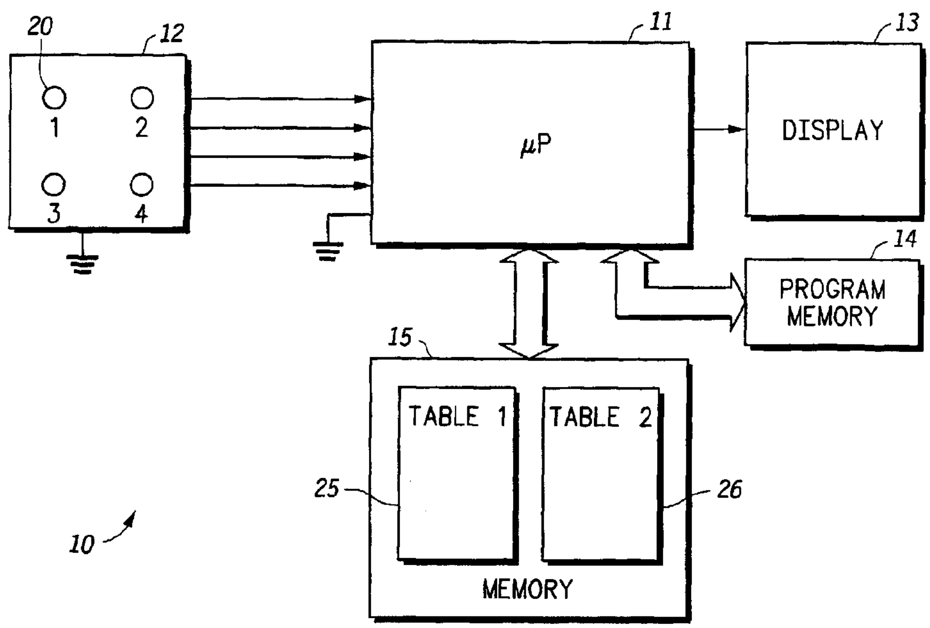
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

[Continued on next page]

(54) Title: IDEOGRAPHIC CHARACTER INPUT USING LEGITIMATE CHARACTERS AS COMPONENTS



(57) Abstract: An apparatus (10) for inputting ideographic characters such as Chinese and Japanese characters from an input pad (12) with ergonomic efficiency in character entry. A method associated with the apparatus (10) facilitates ideographic character input using legitimate characters as components for speeding up the process of ideographic character input. The method extends the normal concept of components and significantly reduces the number of required keystrokes (1-9) when inputting complicated characters while enhancing the efficiency of simple character input.

WO 01/45034 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

IDEOGRAPHIC CHARACTER INPUT USING LEGITIMATE CHARACTERS AS COMPONENTS

FIELD OF THE INVENTION

This invention relates to character input with strokes assigned in a novel manner for input of ideographic text such as Chinese and Japanese, and more particularly to the use of a compact input device with associated software permitting user input of character stroke components, and complete characters, letters, and numerals in a convenient manner.

BACKGROUND OF THE INVENTION

For many years developers of complete keyboards have struggled with the problem of input of Chinese and Japanese text, because these languages use a very large alphabet of characters, more than 13,000 characters, and it is a great problem attempting to devise a keyboard that permits entry of such a large variety of characters from a more limited number of keys. Many proposals and designs exist for using keypad on small hand-held devices for entry of Chinese strokes as part of character input process. In operation, a user simply types in the strokes by pressing the keys in a sequence according to the natural writing order of the strokes of the character he wishes to generate.

Generally, strokes of Chinese characters can be classified into certain number of basic stroke types. A typical example of that number is 26. We refer to such a number as N. These N basic strokes can be further grouped into 5 to 9 stroke categories according to various defining criteria. From now onwards, we refer to the stroke categories simply as strokes. The increasing demand for smaller and smaller devices is driving keyboard design towards one-handed keypad data entry. A keypad typically has only 12 keys (but may have as many as 16 or 24 keys) and is typically used on telephones, mobile telephones and similar devices where one hand of the user is engaged in holding the device (e.g. the telephone earpiece with mobile phone handset) and only one hand is free for data entry.

The prevailing method for entry of Chinese strokes on a keypad requires that each kind of stroke be assigned to a specific key on the keypad. A user types in a stroke by pressing the corresponding key. Others have proposed schemes

of character entry using a 9 or 10-key keypad which are based on entry of strokes and other character components using the same keys for entry of strokes that have some similarity to ideographic character components. It is a drawback of this scheme, however, that the Chinese characters for digits "0" to "9" do not encompass all the strokes required for a full range of character entry, and another drawback exists in that a user may be confused over which key to press between two keys that use broadly similar strokes. Many problems are associated with the constraint that such schemes rely on the user's own acquired associations that the user makes between digits and strokes. Also, in decoding key entry, it is a drawback that the user must enter not just one to three initiated strokes, but also two or one of the last strokes of a character. This requirement causes the user to have to think ahead to the last stroke of a character to enable complete character entry. This requirement may be imposed for disambiguation because the selection of strokes and boxes inadequately spans the range of stroke components required for data entry and therefore inadvertently disambiguates strokes.

There exists two major stroke input methods for ideographic character, namely, the pure stroke input method and the component-based input method. In the pure stroke input method, strokes are grouped into a certain limited number of categories and are input one by one following the actual writing order to retrieve the intended character. For instance, Nokia 7110 cell phone has defined five stroke categories, Ericsson GF768C cell phone has defined eight, and nine strokes are defined and assigned to corresponding keys on the phone keypad on Motorola's CD928C cellular telephone. Advantageously, this provides straightforward, short learning curve and efficient when inputting simple characters. However, this approach can be rather tedious when inputting complicated characters.
For ideographic characters, the number of strokes can easily go above 20, some traditional Chinese characters can even have more than 30 or 40 strokes. For complicated characters, it is not uncommon to see tens of characters share the same precedent component or even components, thus leaving big room for speeding up the input process. Hence comes the component-based input method.

On the other hand, in the component-based input method, a certain number of components are introduced as the intermediate layer between strokes and characters. In the normal sense, a component is a group of contiguous strokes, which

is shared by a certain number of characters as a building block. When inputting characters, a user follows a two-stage process; first inputs strokes to get component candidates, and then selects intended components to retrieve the target character. Thus, this advantageously provides for efficient inputting of complicated characters. By selecting right components, a user saves overall key strokes and narrows the search effectively. The required usage of components, however, is inefficient for inputting simple characters. Unfortunately, most common characters are simple characters. This two-stage process obviously becomes repetitious when dealing with simple characters. In order to build a sufficient layer between strokes and characters, this method typically requires several hundreds of components. For instance, in Ericsson/Zi design, more than 800 components are defined, while in Chinese national standard, 560 components are defined. Some of the components in use are legitimate characters but many of them are not legitimate characters. Unfortunately, those non-character components are simple in their structure, therefore they often appear in the first few screens are inputting the first few strokes. It is very annoying to select one intended character in a mixture of legitimate and illegitimate candidates. This design results in significant reduction in productivity when inputting common and simple characters.

A typical comparison can be drawn like this, in the pure stroke input method, a user gets five (for Motorola CD928C cell phone) to ten (for Motorola V-series cell phone) most frequently used characters in the first screen after keying the first stroke. Statistically, around one-fifth of the time, a user can find the intended character on the first screen simply by typing the first two strokes on Motorola V-series cell phone. On the contrary, in the component-based input method, the chances are reduced to only around 10% in Ericsson/Zi's design.

In operation, a user enters the strokes of a character by pressing on the corresponding keys one at a time. A set of candidate characters is generated and presented on a display as matching alternatives. The displayed set of candidate characters is updated with every entry of a stroke. The user selects the character he or she wants from the set of candidate characters.

Two disadvantages associated with both of the above methods lie first in the separately defined keys and second in the lack of an intuitive relationship between the stroke writing process and the key pressing process. Due to the first

constraint, for every intended stroke a user has to select a specific key among several corresponding keys. When fast or blind typing of strokes is required, a user may encounter many misfires when doing the key selecting and pressing at a fast pace or in a dark environment. The method requires the conversion from the natural stroke writing process to the key pressing process. The relationship between these two is not very straightforward nor highly intuitive. Therefore, in addition to decoding characters into strokes, a user's mind also needs to constantly engage in matching strokes to associated keys. For a casual user, in order to be assured of a correct result, the user's eyes have to monitor not only the set of candidate characters, but also the key pressing on the keypad. It makes the whole character entry process inefficient and stressful.

Other methods of data entry involve writing characters on a tablet using a stylus and performing hand recognition on the input penstrokes. Devices manufactured for this method require a tablet of significant area and generally require a special stylus. The tablet area does not permit use of the method on very small devices such as small mobile telephones. The stylus is an inconvenient additional element, as it can be lost. Two-handed operation is necessary: one hand to hold the device and the other hand to operate the stylus. Such a method is not optimal for a busy user.

There is a need therefore for an improved method and apparatus for data entry where fewer keys are needed, and where there is an intuitive relationship between the writing and the key pressing process, so as to achieve better ergonomic efficiency.

There is a further need for an improved user input method and device for stroke-based ideographic text entry that takes legitimate characters as components for speeding up the process of ideographic character input , which extends the normal concept of components and significantly reduces the number of required key strokes when inputting complicated characters and at the same time enhances the efficiency when inputting simple characters where the selection of strokes are assigned to the stroke or component it represents.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating an embodiment of a data entry device in accordance with the invention.

FIG. 2 illustrates a keypad of nine keys in accordance with the present invention.

FIG. 3 is a flow diagram illustrating operation of the program controlling the microprocessor of FIG. 1.

FIGS. 4a-4f illustrate six fundamental strokes in an alternative embodiment, showing how input can be entered via a sequence of keys.

FIGS. 5, 6, and 7 are a front view, rear view and elevation view respectively of a joystick-type device for use in place of the input device of FIG. 1.

FIGS. 8a and 8b represent an embodiment showing the directional logic provided with an input device.

FIG. 8c is a block diagram of an alternative embodiment input device.

FIG. 9 illustrates input and subsequent display with ideographic character input using legitimate characters as components in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a data entry device 10 (such as a cellular telephone, a wireless messaging communicator, a personal digital assistant, a memo-writer or other device) is shown comprising a microprocessor 11, an input device 12, a display 13 (or other output device such as a RF or IR link), a program memory 14 and a data memory 15.

The input device may take a number of forms, any of which is capable of recording input movement between at least four discrete points arranged in two dimensions. In the preferred embodiment it comprises four push keys 20 in a matrix or square of about 1.5 cm in height and 1.5 cm width, with one key at each corner. For convenience's sake, the top-left key is numbered 1, the top-right 2, the bottom-left 3, and the bottom-right 4. Each key can be sensitive to pressure or sensitive to merely the presence of the fingertip on or near the key. The four keys provide four inputs into the microprocessor. The four inputs are illustrated as four discrete lines,

but it will be understood that four data states can be represented by two data lines (with or without a "data active" line).

The data entry device 10 may have further buttons (not shown) for other functions. For example, it preferably has a 12-key keypad for entry of digits 0-9 and for calling. Scrolling keys may be provided for menu control.

The memory 15 is illustrated as having two tables 25 and 26. Tables are not essential, but it will be explained below that tables are a useful and convenient manner of translating inputs from the input device 12 into primitive handwriting elements and (if required by the ultimate character set of the language in question) for translating primitive handwriting elements into data characters.

In operation, a user enters vector or movement strokes into the input device 12 by passing his or her finger across the keys 20 in two dimensions in a horizontal plane. The input device 12 generates a series or sequence of discrete inputs to the microprocessor 11, dependent on the keys activated. This is explained in greater detail below with reference to language examples. The microprocessor, under the control of program code stored in program memory 14, performs a look-up or search operation in the memory 15 to uniquely identify the intended character or to identify the most likely intended character.

Where a character is uniquely identified by the microprocessor 11, it is displayed on display 13. Where several likely intended characters are identified, one or more is or are displayed on display 13. Where one character only is displayed, the character that is deemed to be the most likely intended character is displayed. Where several candidate characters are displayed, these are displayed in a selection list in decreasing order of likelihood of usage. Likelihood of intended usage is determined by frequency information in the memory 15, showing the frequency of usage of a character in the language in question (or the relative frequency of usage from among several candidates) or the frequency of usage of a character in the context of the character in the language (e.g. taking into account the previous N characters).

FIG. 2 illustrates a keypad 10 of nine keys 1-9 in a standard 3x3 arrangement. Each key has a stroke component assigned to it (as well as a digit, not shown).

Key 1 has a "turn right" component comprising a vertical (south) or backslash (south-west) stroke followed by a turn to the right.

Key 2 has a dot.

Key 3 has a horizontal-and-turn component (with no hook).

Key 4 has a left stroke - i.e. down-and-left (south-west).

Key 5 has a vertical stroke (straight down with little or no slope).

Key 6 has a right down-stroke (south-east).

Key 7 has a right hook component - i.e. the end of the stroke is right with an upward turn.

Key 8 has a horizontal stroke (left-to-right), and

Key 9 has a left hook component (ending with a turn to the left and a small upward "hook" stroke).

This embodiment relates to a method that takes legitimate characters as components for speeding up the process of ideographic character input. Here, the legitimate characters are referred to those defined in the working character set under the GB, Big5 or Unicode standard. Unicode is a 16-bit system for encoding letters and characters of all the world's languages which can encode 65,536 characters. Sixteen-bit characters (like Unicode) are also called Wide Characters. The first 128 codes of Unicode are identical to ASCII. Just add another zero byte to each ASCII character to convert to Unicode. Unicode contains over 20,000 Han characters, which are used to represent whole words or concepts in Chinese, Japanese, and Korean. This novel method extends the normal concept of components and significantly reduces the number of required key strokes when inputting complicated characters and at the same time enhances the efficiency when inputting simple characters.

It is a feature of Chinese writing that pen movement is generally top-to-bottom. The exceptions to this rule are left-hooks and right-hooks, where the stroke ends with a short upward component. In operation, a user presses the keys 1-9 in a sequence according to the strokes of a character he wishes to generate. Each keystroke generates a digit which is delivered to a character search engine in a manner described in greater detail below. The user has one simple rule to which he needs to work, which is as follows. If a component includes a hook, the user must select one of keys 7 and 9 (according to the direction of the hook). Otherwise, the

user selects one of keys 1 through 6 and 8 according to the shape of the character component being generated. In other words, a hook is generated with key 7 or 9 regardless of what other strokes and turns make up that component.

A component table is provided taken from the national standard of character components. A portion of this component table holds legitimate characters and the seventeen components of the standard that are single-stroke components, i.e., it gives the first two components that are 2-stroke components. The standard defines 560 components in total. The right hand column give a 3-digit number from 1 to 560 which identifies the component.

With reference to FIG. 9, ideographic characters may be drawn from stroke entries from a keypad on a small device such as a cellular phone, by providing for stroke input sequences on a telephone keypad or other compact data input devices providing for character input on a stroke by stroke basis. The Chinese or Japanese character may be drawn from keypad entry, however input of such characters is usually quite slow and tedious for complex characters. The process of ideographic character input using legitimate characters as components in FIG. 9 proceeds as below. Accordingly, the described embodiments provide for a speeding up of the process of character input by allowing for ideographic character input using legitimate characters as components. Reference numerals 30 and 32 represent the sequential input of back slash and forward slash strokes input, e.g., on the keypad as entries 4 and 6, which yield a display on the device 10 as illustrated by reference numeral 34 which provides both a subcomponent of a ideographic character to the left-hand side of the display, and a complete legitimate ideographic character on the right-hand of the display. Where the legitimate character is selected by the user, as illustrated by selection reference numeral 36, the legitimate character selection is provided as input to the device. On the other hand, where the component shown with the legitimate character to the left is selected, further characters and character components are shown on the display as illustrated by reference numeral 38, from which complete legitimate character and character subcomponents may be selected as illustrated by reference numeral 40. Using complex English words to exemplify the problem associated with complex Chinese characters and the like, complex words such as inter-national-ization, may be parsed into multiple segments which may be recognized during the course of data entry. Thus, whereas letter by letter entry of

such complex words is slow and tedious, software recognizing legitimate sections of words, e.g., "inter," "national," and the like, facilitates character entry through components of words or ideographic characters. By recognizing that such complex words are made up of legitimate component words, one approach may provide the user with possible legitimate words and subcomponents for selection during character entry to speed the entry process.

Accordingly, rather than showing all subcomponents, e.g., inter, ization, only legitimate words or characters are provided, such that the subcomponents would not be shown but rather only complete words, e.g., internationalization, national, and the like, to provide complete word choices to the user in the limited display area of portable devices such as cellular phones. Taking for example "inter" as a Chinese character component, and "national" as a additional Chinese character component, then a complicated Chinese word can be treated as a composition of multiple simpler Chinese characters. Thus, whereas input of simple Chinese characters on a stroke by stroke basis is satisfactory, the input of more complicated characters becomes unduly burdensome, and thus the input of a few strokes to provide input of the simpler character is designated for yielding upon request, display of all characters including complex characters associated with the component entry to facilitate the selection of legitimate characters by the user. This may be provided in an iterative process, i.e., upon selection of characters following the earlier component entry, additional strokes may be added to the selected character to further define the character.

As illustrated in FIG. 3 herein, is a further table 27 of characters located at addresses corresponding to character addresses from table 26. A character is read from table 27 located at a character address obtained from table 26. Characters in the table 27 that have a common stroke sequence (or common digit stream) are stored in order of relatively decreasing frequency of use. This scheme allows for changing the relative addresses of characters in the table 27 to adjust for relative frequency of use of characters. A further table 28 can optionally be provided to perform bigram look-up operations. The output of table 27 (or table 28 if used) is standard hexGB coding of one or more Chinese characters. A further look-up is used to obtain and display the pictorial representation of the character.

The above method has the following two notable and advantageous features. First, it makes use of only four keys. Therefore, the keypad can be relatively small in size. The four keys are distinctively positioned, the chance of getting confused with different keys and thus resulting misfires on wrong keys has been greatly reduced.

Second, this method does not require a one-to-one match from an actual writing stroke to a designated key. Instead, it associates the thumb move path over the keys with the actual writing trajectory of the intended stroke. This builds an intuitive relationship between the stroke writing and key pressing processes. In addition, the definition of six fundamental strokes allows 17 different kinds of entry variations in total, which cover all N basic stroke types. It has an unprecedented feature that the majority of basic strokes can be drawn on the 4-key keypad. This scheme makes it possible that a user only needs to look at the set of candidate characters and make a selection among them without the need of watching closely the movement of the thumb over the keys on the keypad. It allows a user to input strokes in a natural and convenient manner.

In operation, a user enters strokes for a character or set of candidate characters identified by the sequence of digits received from the keypad 10. A table of handwriting input identifiers (e.g. strokes, character components, characters or pseudo-characters) is stored in memory with at least one series of discrete inputs for each handwriting input identifier. The table of handwriting input identifiers is indexed (e.g. by a look-up operation or a search operation) with a series of discrete inputs received from the array of switching elements. In this manner, a handwriting input represented by the series of discrete inputs is identified and may be displayed to the user or stored or otherwise used as original data entry.

When a character or set of candidate characters have been identified from the memory and displayed on display 31. The keypad 10 or some other "select" key or " next character" key can be used to select the displayed character or a selected one of a series of displayed candidate character. Alternatively, the speaker 35 can be used to enunciate the character or the candidate characters.

It is clear that the pure stroke input is the baseline while the component-based input is only efficient for complicated characters but inefficient for simple characters. Thus, the object is to find a good balance between the two.

Accordingly, a good character input method ought to be well balanced in making use of components: on one hand, supporting component-based input for efficient input of complicated characters; and on the other hand, without introducing extra non-character components to avoid penalties on input of simple characters.

For long time, there exists several hundreds of so-called common-sense components. As said above, some of them are legitimate characters already and the rest are not. In this invention, only those legitimate characters among the common sense components are taken as the components to use. In addition, if one legitimate character forms the common precedent part of a certain number of characters, although it is not a common-sense component, it will be taken as a component to use. Therefore, in the new definition of components, there are both components in the normal sense and components in this new sense.

In operation, after a use enters one or a few strokes, a list of candidate characters will display to the user. Among the candidate characters, some are components, selecting any of them rings out a new list of candidate characters starting with the selected component, while some are not components, selecting any of them has no effect. Nevertheless, all displayed candidate characters are legitimate characters. Once a user selects a character as a component for further candidate retrieving, after a new list of candidate characters gets displayed to him, he can again make selections of characters as component for further retrieving. Therefore, this process can be recursive. In the meantime, if the entered stroke or strokes already suffice to retrieve the intended character, the user only needs to select and confirm on the intended character without further bothering with component.

Thus, an apparatus has been described for inputting ideographic characters comprising an input pad 10 having a look-up table stored in the memory 33. The look-up table comprises ideographic characters sorted into a plurality of groups, each group being represented by a common sequence of input keys. A user enters at least a first and a second input key entry, and based on a sequence of input key entries received, the microprocessor 30 identifies at least one ideographic character corresponding to the sequence of input key entries.

Accordingly, the input device or input pad 10 coupled with the microprocessor 11 and the memory 33 allows for information processing with the microprocessor 11 for retrieval of legitimate ideographic characters as well as

ideographic character components from the memory 33. Thus, legitimate ideographic characters and character components may be displayed side by side for user selection to facilitate either the ultimate selection or further definition of the ideographic characters intended for input by the user. The look-up table is provided as being associated with the memory 33 for facilitating display of associated ideographic character components with the legitimate ideographic characters for selection of the legitimate characters from the memory 33. Additionally, the look-up table filters the ideographic character components from the legitimate ideographic characters for display. Where the selection of ideographic characters is provided by the user, the selection further facilitates input via the input device 10 allowing the input device 10 to provide further stroke components to a selected legitimate character to further define the ideographic character being input by the user. Thus, the described method and apparatus provides for significant speeding up of the ideographic character input by taking the legitimate characters as components to the input ideographic characters being provided by the user.

A computer program is stored in read-only memory associated with the microprocessor 30 and has instructions and data which, when loaded into the microprocessor or other computer, cause the microprocessor to perform a look-up operation to determine at least one ideographic character corresponding to a sequence of digits representing such strokes. In another aspect, the computer program causes the microprocessor or other computer to receive legitimate characters as components.

With reference to FIGS. 4a-4f, a brief description of the six fundamental strokes in an alternative embodiment, showing how input can be entered via sequence of keys. A stroke is classified as "clockwise turn" type if and only if the first turn of the stroke is of clockwise direction, no matter how many turns may follow thereafter and no matter what direction they are. The same applies to the "counter-clockwise turn" stroke type. A thumb move path is the sequence of keys which have been visited during a preset time period from the first key of the sequence being visited until a pre-defined time-off is detected. A time-off is the time elapse from the moment the previous key is visited to the moment the next key is visited.

Upon entering strokes using discrete thumb, finger, stylus, trackball, mouse or other two-dimensional stroke inputs, i.e. discrete signals representative of discrete vectors, the microprocessor 11 translates the vector inputs into strokes and

then performs a tabular look-up or other search in table 26 in memory 15 for Chinese characters corresponding to the stroke inputs. A two-stage translation is preferred, as this reduces the size of table 26, but it is not necessary. Chinese character identifiers can alternatively be stored in table 26 in a manner indexable by a raw vector input sequence. Alternatively, in accordance with the teaching of the present invention, the digit streams can be key sequences representative of stroke vectors.

On a well-designed keypad, the strokes can be drawn by moving around the thumb or a finger. Thus, the letter "A" can be drawn in four (or more) ways and can be drawn as a single pen-down (or thumb-down) stroke (as in "Graffiti") or using two pen-down strokes, each starting at the apex.

Referring to FIGS. 5, 6 and 7, hardware variations are illustrated in which a front view, rear view and elevation view respectively of an alternative input device 50 are shown. The alternative input device has a joystick element 100 (which term is to be understood as including other button or lever devices moveable in two dimensions in a horizontal plane, including mouse-buttons). The joystick element 100 is mounted on a spring-loaded mounting illustrated as a ball-and-socket mounting 101 by way of example. The mounting is biased such that the joystick element returns to a central resting position when not under thumb or finger pressure. Springs 104-107 are shown as providing bias, but it will be understood that these need not be discrete helical springs and may be replaced by a single elastomeric member. Four discrete contacts 110-113 are shown at four equally spaced compass points around the center (north-west, north-east, south-east and south-west respectively).

As shown in FIG. 6, there is a silvered circle 120 on the rear of the ball of the ball-and-socket mounting 101 and there is a ground contact 121 fixed relative to the ball-and socket mounting and positioned centrally behind the ball.

In operation, a user moves the joystick element 100 with his or her thumb or finger and the ball rotates such that the silvered circle 120 makes contact between the ground contact 121 and one of the discrete compass-point contacts 110-113. In this way, the input device of FIG. 5 can generate a series of discrete inputs just like the four-key input device 12 of FIG. 1. A north-west movement of the joystick generates the same input as key 1 of input device 12, and so on.

It will be understood by one of ordinary skill in the act that other joystick elements can achieve the same result. For example, a ball-and-socket arrangement with an asymmetric ball can be used that activates four or more microswitches similar to the buttons of input device 12 of FIG. 1. The joystick does not need to have a ball-and-socket at all.

It will also be understood by one of ordinary skill in the art that more than four contacts can be used for the input device 12 of FIG. 1 or the input device 50 of FIG. 5. For example, six, eight, twelve or sixteen compass point contacts can be used. Alternatively, a matrix of 3X3 or 4X4 buttons or contacts could be used. Tables 1 and 2 would need to be reformulated accordingly, and there would be many more stroke variations permissible for each item in these tables. Alternatively, the joystick button input device of FIG. 5 does not have a ball-and-socket, but is fixed on its mounting and uses orthogonal strain gauge elements to provide a continuous (i.e. progressive, non-discrete) 2-dimensional output (e.g. two analog voltage outputs) which is divided into discrete values by the microprocessor 11 or by an interface into the microprocessor 11 (e.g. an analog-to-digital converter).

Referring to FIG. 7, a microswitch 150 is shown mounted beneath the ball-and-socket mounting 101 of the input device 50 of FIG. 5. The microswitch 150 is a push-to-make switch and can be used for a number of purposes.

In one embodiment, the microswitch 150 is used as a pen-down indicator. In this variation, a single input stroke is measured from pen-down to pen-up. This has the advantage of disambiguating between pen-down and pen-up segments. All contiguous pen-down segments can be captured and used for character recognition, regardless of whether they are captured within a time-out time or after expiry of a time-out timer. This allows for greater flexibility in user-variations of time duration when entering strokes or characters. A "data active" line on the input device 12 of FIG. 1 can perform the same function, such that all continuous thumb-down movements cause an activation of at least one button and cause activation of the "data active" line, whereas a thumb-up event gives no data active signal. Instead of a data active line, timing measurements by the processor 11 can be used to measure the time lapse between button presses (if any) and so determine if there has been a thumb-up event.

In FIG. 8a, a joystick element 200 is shown having strain gauges (or other analog elements) 201 and 202 that provide analog movement indications for movement of the joystick element 200 in orthogonal x and y dimensions in a horizontal plane. Integral with the joystick element 200 is a push switch 204, preferably a push-to-make switch.

The analog elements 201 and 202 are connected to analog-to-digital (A/D) converters 210 and 211 (or to a single shared A/D converter), which are coupled to a processor 220. The switch 204 is also coupled to the processor 220.

The processor 220 has a program stored in program memory that causes it to perform a scaling (normalizing) function 221 on the inputs from the A/D converters 210 and 211. Inputs from the A/D converters are accepted by the scaling function 221 when the switch 204 indicates a "push" condition (equivalent to a pen-down state). Following the scaling function, an optional smoothing function 222 is carried out and a segmentation function 223. The segmentation function segments the two-dimensional input into segments at natural bends in the input, thereby providing a sequence of raw stroke segments. A matching function 224 matches the segments against pre-stored templates from template store 230 in a manner known in the art.

The arrangement of FIGS. 8a-8c and particularly the arrangements 50, 52, and 54 are useful for entry and recognition of ideographic characters (e.g. Chinese characters), but is not limited thereto, and is useful for Roman character entry or Graffiti (trade mark) type of stroke entry. Input of character components as illustrated in FIG. 9 also may be provided with the nine digit keypad of FIG. 2, as discussed above. The smoothing, segmenting and matching steps can be modified (or omitted where unnecessary) to suit the type of data entry.

What is claimed is:

1. A method for inputting ideographic characters, comprising:

providing user input of character stroke components;

processing the input of the character stroke components with an information processor (11);

coupling the information processor with a memory storage device (15) for retrieval of legitimate ideographic characters and character components relative to the user input of the character stroke components provided by the providing step; and

associating a look-up table with the memory storage device (15) coupled with the information processor (11) for displaying associated ideographic components with the legitimate ideographic characters in the displaying step for selection of the legitimate ideographic characters.

2. A method as recited in claim 1, wherein the inputting step comprises the provision of a keypad (10) having stroke components assigned with digit keys for user input of the character stroke components.

3. A method as recited in claim 1, wherein the associating step for the look-up table filters ideographic character components from the legitimate ideographic characters for display by the displaying step.

4. A method as recited in claim 1, wherein upon selection of a legitimate ideographic character, further input at the inputting step allows further stroke component input to a selected legitimate character to further define the ideographic character.

5. An apparatus for inputting ideographic characters, comprising:

an input device (12);

a microprocessor (11) coupled to said input device (12);

a memory (15) coupled to said microprocessor (11) for retrieval of legitimate ideographic characters and character components;

a display (13) for displaying the legitimate ideographic characters and character components; and

a look-up table associated with said memory (15) and said display (13) for associating ideographic character components with the legitimate ideographic characters for selection of the legitimate characters from said memory (15) for said display (13).

6. An apparatus as recited in claim 5, wherein said input device comprises a multi-key keypad (10) having associated ideographic character stroke components for mapping a stroke to each of the multiple keys.

7. An apparatus as recited in claim 5, wherein said input device comprises an array of switching elements (20) capable of recording input movement in two dimensions.

8. An apparatus as recited in claim 5, wherein said look-up table filters ideographic character components from the legitimate ideographic characters for display on said display (13).

9. An apparatus as recited in claim 5, wherein upon selection of a legitimate ideographic character, further input via said input device (10) allows said input device (10) to provide further stroke components to a selected legitimate character to further define the ideographic character selected.

10. An apparatus for inputting ideographic characters, comprising:

means (10) for inputting character stroke components;

means (30) for processing coupled with said means for inputting for information processing of the character stroke components;

means (33) for storing information processed by said means for processing for retrieval of legitimate ideographic characters and character components;

means (38) for displaying the legitimate ideographic characters and character components; and

means (30) for associating a look-up table of ideographic character components with legitimate ideographic characters for selection of the legitimate characters for said means for displaying.

11. An apparatus as recited in claim 10, wherein said means (11) for inputting comprises switching means (12) capable of recording user input movement in two dimensions.

12. An apparatus as recited in claim 10, wherein said means (30) for associating the look-up table performs filtering of the ideographic character components from the legitimate ideographic characters for said means for displaying.

13. An apparatus as recited in claim 10, comprising means (30) for selecting legitimate ideographic characters and means (12) for further input of ideographic character components providing further stroke components to be selected as legitimate ideographic characters to further define the ideographic character input.

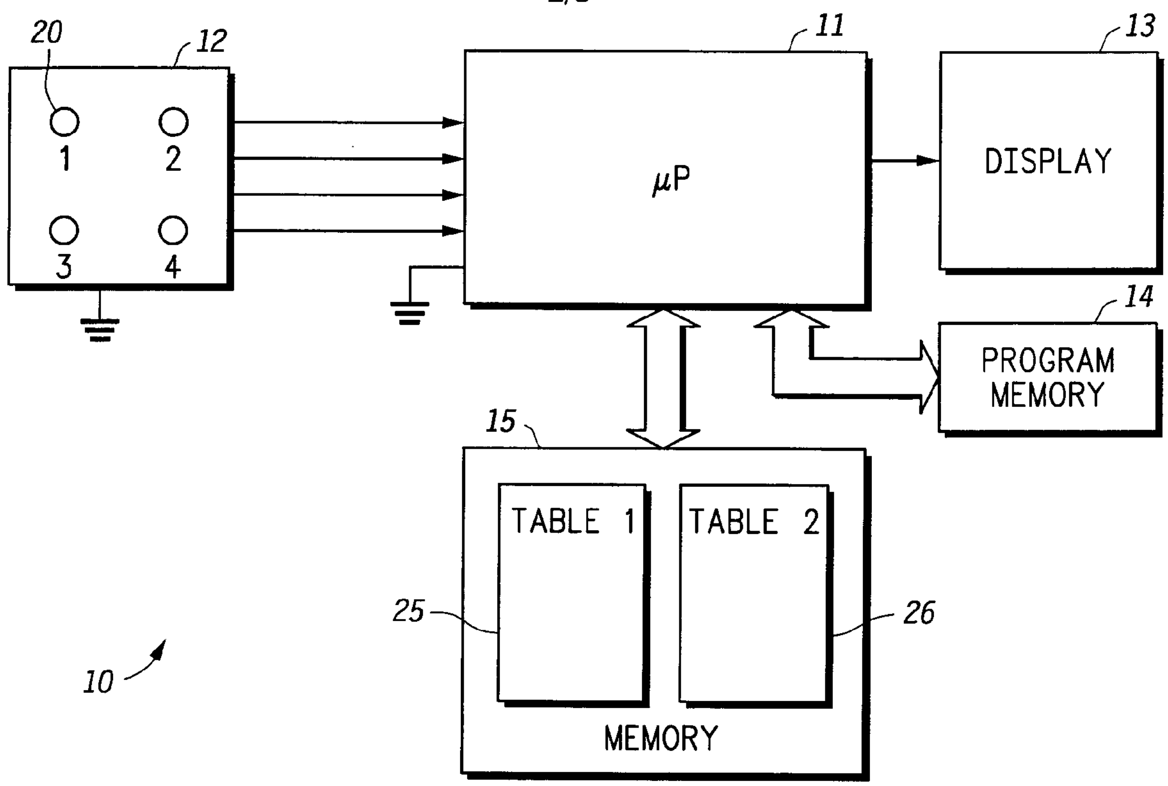

20
12
11
13
1
2
3
4
μP
DISPLAY
14
PROGRAM MEMORY
15
TABLE 1
TABLE 2
25
26
MEMORY
10

FIG.1

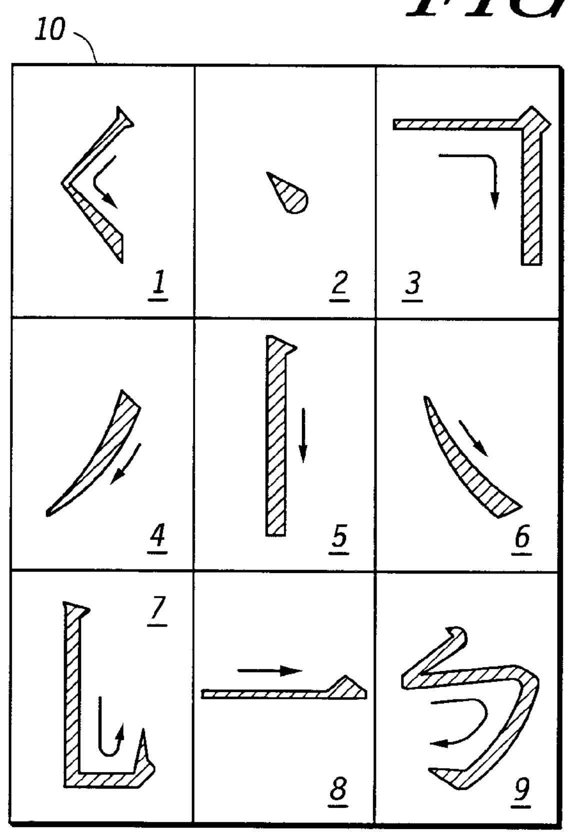

10
1
2
3
4
5
6
7
8
9

FIG.2

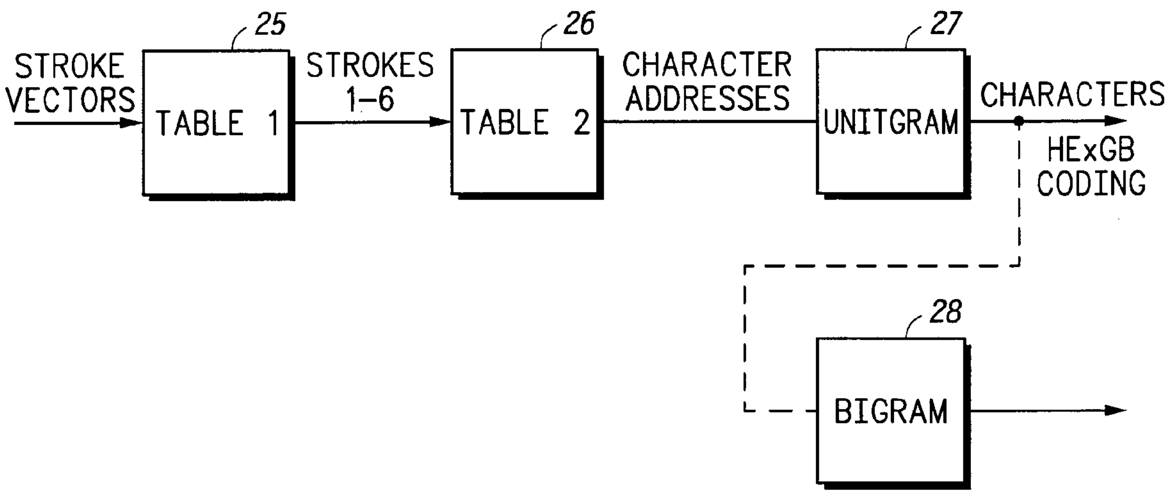


FIG.3

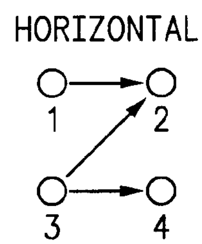


FIG.4a

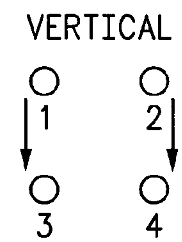


FIG.4b

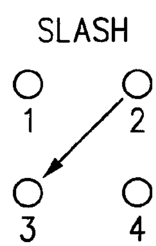


FIG.4c

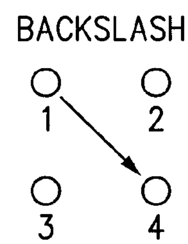


FIG.4d

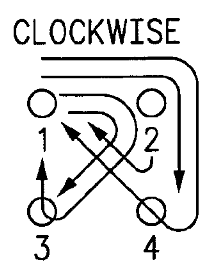


FIG.4e

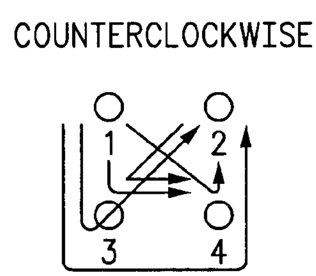


FIG.4f

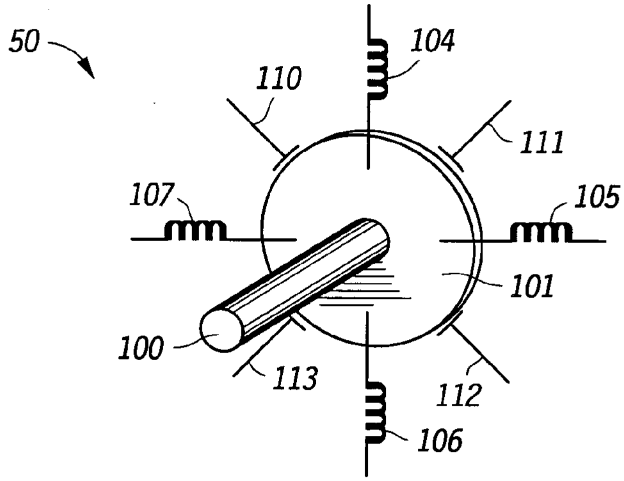


FIG.5

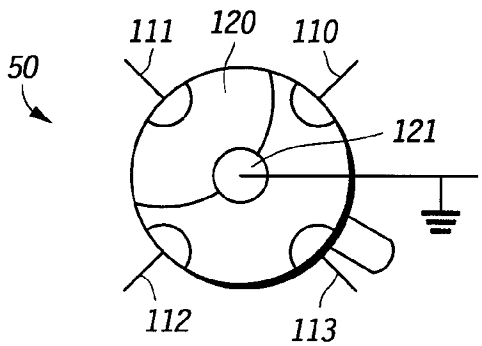


FIG.6

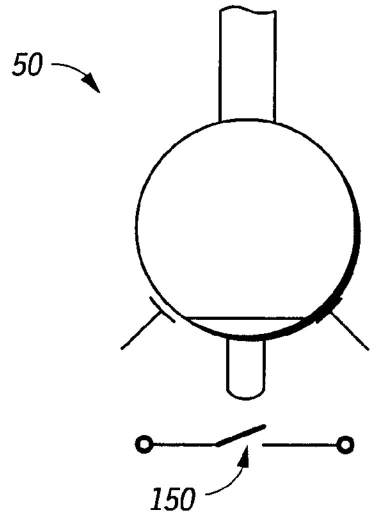


FIG.7

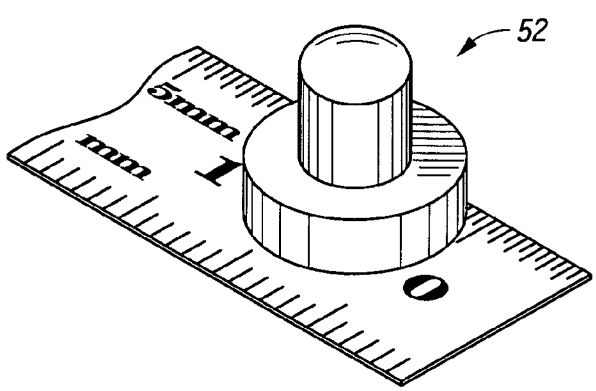


FIG.8a

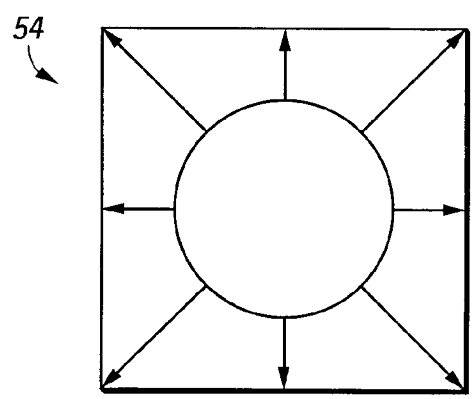
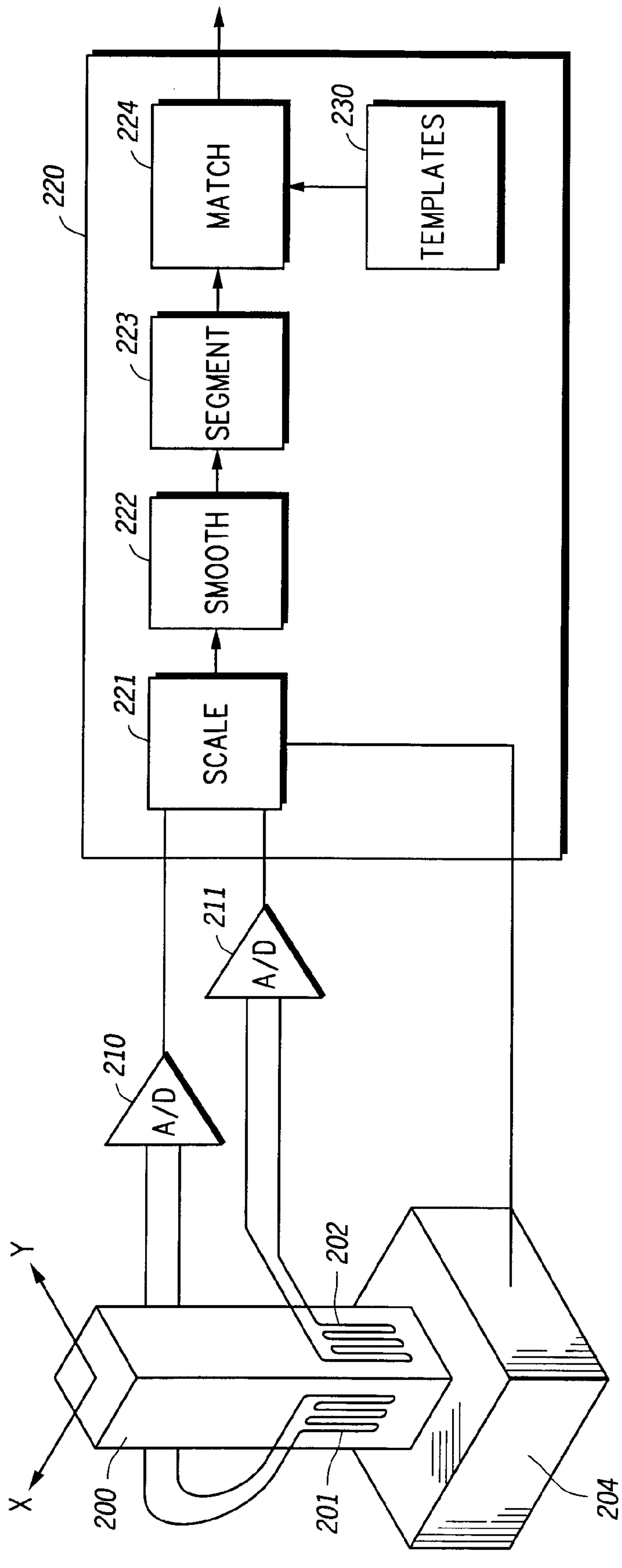


FIG.8b



SCALE
SMOOTH
SEGMENT
MATCH
TEMPLATES
A/D
A/D
X
Y
220
221
222
223
224
230
210
211
200
201
202
204

FIG.8c

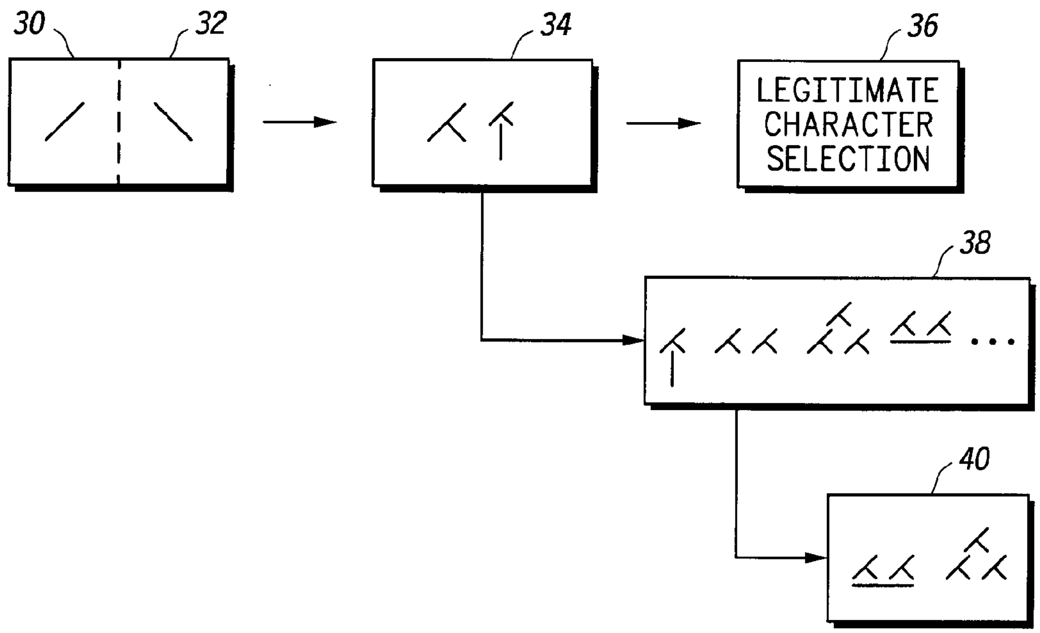


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/33214

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06K 9/00, 9/18, 9/62, 9/64, 9/68; G06F 15/00; H03K 17/94, 11/00
US CL : 382/185, 186, 187, 189, 209, 217, 218; 707/535; 341/28
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 382/185, 186, 187, 189, 209, 217, 218; 707/535; 341/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NPL (IEEE)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,212,769 A (PONG) 18 May 1993, col. 10, lines 17-29; col. 10, lines 52-56; col. 11, lines 15-42.	1-13
Y	US 5,109,352 A (O' DELL) 28 April 1992, col. 12, lines 32-60; col. 14, lines 1-46.	1-13
Y	US 4,379,288 A (LEUNG et al) 05 April 1983, col. 9, lines 42-65.	2 and 6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 JANUARY 2001	22 FEB 2001

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	MEHRDAD DASTOURI
Facsimile No. (703) 305-3230	Telephone No. (703) 305-2438